# NAVAL POSTGRADUATE SCHOOL

**MONTEREY, CALIFORNIA**

**MBA PROFESSIONAL REPORT**

# THE EFFECT OF ZONING LAWS ON HOUSING PRICES AND BAH RATES

**December 2014**

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| REPORT DOCUMENTATION PAGE | *Form Approved OMB No. 0704-0188* |
|---|---|



| **1. AGENCY USE ONLY** ***(Leave blank)*** | **2. REPORT DATE**<br>December 2014 | **3. REPORT TYPE AND DATES COVERED**<br>MBA Professional Report |
|---|---|---|

**4. TITLE AND SUBTITLE**
THE EFFECT OF ZONING LAWS ON HOUSING PRICES AND BAH RATES

**5. FUNDING NUMBERS**

**6. AUTHOR(S)** William Fitzkee

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**
Naval Postgraduate School
Monterey, CA 93943-5000

**8. PERFORMING ORGANIZATION REPORT NUMBER**

**9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
N/A

**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**

**11. SUPPLEMENTARY NOTES** The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number ____N/A____.

**12a. DISTRIBUTION / AVAILABILITY STATEMENT**
Approved for public release; distribution is unlimited

**12b. DISTRIBUTION CODE**

**13. ABSTRACT (maximum 200 words)**

This thesis is an analysis of the effect of zoning laws and regulations on the price of residential housing. Economists Edward Glaeser and Joseph Gyourko have completed significant work on this topic. Their efforts have focused on the correlation of high housing prices with zoning laws and other land-use controls, but stop short of estimating the impact of zoning laws on actual housing prices in specific markets. This thesis expands on their research and estimates what residential housing prices would be without the regulations. It also estimates the deadweight loss (DWL) caused by the zoning laws in various high-cost markets. The results show significant price reductions from both complete and partial elimination of zoning restrictions. This thesis also uses these estimates to calculate the impact of the zoning laws on Basic Allowance for Housing (BAH) in the markets analyzed. Estimated BAH rates with zoning reduced or eliminated were substantially lower in many of the high-cost housing markets studied.

**14. SUBJECT TERMS**
zoning laws, land-use restrictions, housing prices, basic allowance for housing, housing supply

**15. NUMBER OF PAGES**
63

**16. PRICE CODE**

| **17. SECURITY CLASSIFICATION OF REPORT** | **18. SECURITY CLASSIFICATION OF THIS PAGE** | **19. SECURITY CLASSIFICATION OF ABSTRACT** | **20. LIMITATION OF ABSTRACT** |
|---|---|---|---|
| Unclassified | Unclassified | Unclassified | UU |

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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**THE EFFECT OF ZONING LAWS ON HOUSING PRICES AND BAH RATES**

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Submitted in partial fulfillment of the requirements for the degree of

**MASTER OF BUSINESS ADMINISTRATION**

from the

**NAVAL POSTGRADUATE SCHOOL**
**December 2014**

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# THE EFFECT OF ZONING LAWS ON HOUSING PRICES AND BAH RATES

## ABSTRACT

This thesis is an analysis of the effect of zoning laws and regulations on the price of residential housing. Economists Edward Glaeser and Joseph Gyourko have completed significant work on this topic. Their efforts have focused on the correlation of high housing prices with zoning laws and other land-use controls, but stop short of estimating the impact of zoning laws on actual housing prices in specific markets. This thesis expands on their research and estimates what residential housing prices would be without the regulations. It also estimates the deadweight loss (DWL) caused by the zoning laws in various high-cost markets. The results show significant price reductions from both complete and partial elimination of zoning restrictions. This thesis also uses these estimates to calculate the impact of the zoning laws on Basic Allowance for Housing (BAH) in the markets analyzed. Estimated BAH rates with zoning reduced or eliminated were substantially lower in many of the high-cost housing markets studied.

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACS | American Community Survey |
| AHS | American Housing Survey |
| BAH | Basic Allowance for Housing |
| CC | construction costs |
| DOA | Department of the Army |
| DOAF | Department of the Air Force |
| DOD | Department of Defense |
| DON | Department of the Navy |
| DTMO | Defense Travel Management Office |
| DWL | deadweight loss |
| HOA | homeowner association |
| MHA | Military Housing Area |
| NAHB | National Association of Home Builders |
| OUSD(C) | Office of the Under Secretary of Defense (Comptroller) |
| P | equilibrium price without zoning regulation |
| $P_{75}$ | equilibrium price with a 75% reduction in zoning regulation |
| $P_{50}$ | equilibrium price with a 50% reduction in zoning regulation |
| $P^{I}$ | price prime, equilibrium price with zoning regulation |
| Q | equilibrium quantity supplied without zoning regulation |
| $Q_{75}$ | equilibrium quantity supplied with a 75% zoning reduction |
| $Q_{50}$ | equilibrium quantity supplied with a 50% zoning reduction |
| $Q^{I}$ | quantity prime, equilibrium quantity supplied with zoning |
| USA | United States Army |
| USAF | United States Air Force |
| USMC | United States Marine Corps |
| $\eta_d$ | price elasticity of demand |
| $\eta_s$ | price elasticity of supply |

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# I. INTRODUCTION

Zoning laws and other land-use restrictions can have a significant impact on the price of housing. Housing costs can be decomposed into three elements; construction costs (CC), the cost of land, and the costs associated with obtaining the legal right to build a structure on the land (Glaeser, Gyourko, & Saks, 2005). Since 1970, construction costs for housing have declined in real terms, yet during that same period real housing prices in the United States have steadily climbed an average of 1.7% annually (Glaeser et al., 2005). In some markets these increases have been much greater. The main driver of this increase in housing costs appears to be government regulation in the form of zoning laws and various other types of land-use restrictions and taxes (Glaeser & Gyourko, 2002). Many of these restrictions impose artificial limits on the supply of housing, and the result is housing prices that are well above the actual cost of construction and the implicit value of the land (Glaeser & Gyourko, 2002). Other types of land-use regulations act like a tax on the construction of new housing. Both forms of zoning regulation result in a higher market equilibrium price for housing, lower equilibrium quantity, and an associated deadweight loss (DWL). The aggregate effect of all zoning regulations and land-use restrictions in a metropolitan area is referred to as the zoning "tax." The increase in price and the size of the DWL will vary depending on the amount of zoning regulation (size of the zoning tax), and the price elasticity of supply and demand.

Glaeser and Gyourko (2002) proved that the steep prices seen in various high-cost housing markets was the result of zoning regulation as opposed to the traditional economic view of land scarcity. This paper furthers their research and explores the effect of zoning on housing prices, specifically calculating what the price would be without zoning or with a reduction in zoning regulation. In addition, the DWL that is associated with zoning regulations is calculated. A linear regression of the calculated DWL for each metropolitan area on an index that measures the level of regulation is conducted to test the correlation between DWL and the level of land-use restrictions. Lastly, the impact of zoning regulations on Basic Allowance for Housing (BAH) rates, which is a sizeable portion of the Department of Defense (DOD) budget, is analyzed. Specifically, the

potential price reductions for housing from the elimination or easing of zoning regulations are applied to the BAH rate calculation methodology to determine what BAH rates would be without zoning regulation or with reduced zoning in the markets studied.

Using the data from Glaeser and Gyourko (2002), a range of potential percentage price decreases is calculated for each market studied. There is no way to directly measure or calculate with complete certainty what housing prices would be without land-use restrictions. The method chosen in this paper utilizes Glaeser and Gyourko's (2002) calculations for the implicit price of land from the hedonic method and the extensive value of land including zoning taxes. Comparing these two values gives the percentage of the median housing price that is above construction costs (CC) attributable to zoning regulation. The result is an *implicit zoning tax percentage* for each market studied. This implicit zoning tax percentage is then subtracted from the median housing price for owner-occupied housing from the 2012 American Community Survey (ACS) to calculate what the price would be without any zoning regulation, which is referred to as the equilibrium price (P). P for a 75% zoning reduction and a 50% zoning reduction is also calculated to give a realistic range for the amount of zoning regulation that could feasibly be eliminated in an effort by local governments to make housing more affordable.

The median price of owner-occupied housing with zoning regulation is referred to as equilibrium price prime ($P^I$). The equilibrium quantity supplied with zoning is called $Q^I$. These values are obtained from the 2012 ACS for the markets studied by Glaeser and Gyourko (2002). This paper uses a range of values for the price elasticity of housing demand ($\eta_d$) that have been estimated in previous studies by Muth (1971), Polinsky and Ellwood (1979), and Hanushek and Quigley (1980). The $\eta_d$ values used are -.3, -.5, -.7, and -.9. With $P^I$, $Q^I$, the calculated P values, and $\eta_d$, we can determine the quantity supplied without zoning regulation and for various levels of zoning reduction. This value is referred to as Q.

With Q and P values for a 100% zoning regulation reduction and $\eta_d$ of -.5, the DWL associated with the zoning tax in the various markets studied is calculated. This DWL represents the loss to society that is a result of the zoning regulations. A linear

regression is then performed of these estimated DWL values on the regulatory index values from Malpezzi (1996).

The final portion of the paper examines how land-use restrictions affect BAH rates. The 2012 BAH rates for the markets studied are obtained from Defense Travel Management Office (DTMO). BAH rates are calculated using estimated median market rent prices for various types of dwellings depending on the rank of the service member and dependent status. The types of dwellings used range from apartments to detached single-family homes. The average cost of utilities and renter's insurance is also factored into the BAH rate calculation. DTMO provides a BAH component breakdown that specifies an average percentage for the rent portion of the BAH rate in each market. This is the portion of BAH that is affected by zoning regulation.

Rent and house prices are highly correlated. The rent-price ratio is the metric typically used to describe this relationship. The rent-price ratio is calculated by dividing average annual rent by median price. Historically, the rent-price has averaged 5%, with little variation (Davis, Lehnert, & Martin, 2008). Any reduction in the price of housing is going to correlate to a proportional reduction in market rent. Using the calculated *implicit zoning tax percentage*, BAH rates for a 100%, 75%, and 50% reduction to the zoning tax are estimated for each metropolitan area.

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# II. LITERATURE REVIEW

## A. ZONING LAWS AND LAND-USE REGULATIONS

The subject of zoning is a complex and vast subject that overlaps multiple academic areas, including economics, the law, and other social sciences. This paper focuses on the economic aspect of the zoning and land-use restrictions prevalent in municipalities across the United States. A brief history of zoning and its different forms follows. This paper uses the terms zoning and land-use restrictions interchangeably to describe any type of zoning law.

According to Deakin (1989) there are five general categories of zoning and land-use restrictions:

1. Restrictions on location, density, and intensity of development
2. Regulations on design and performance for lots and structures
3. Costs levied on building developers for new construction
4. Moratorium on development in specific areas
5. Various controls on growth of buildings and population

These categories are broad and include many different types of laws that control the use and development of land. The first category includes the traditional zoning for residential or commercial use of land. Also in this category are the laws that mandate minimum lot sizes and the type of residential structures (i.e. single-family detached, multi-family, apartment, etc.). Most zoning laws in this country prior to 1970 fall into this category (Fischel, 2004). The second category essentially covers the building codes. The third category includes fees levied by local governments on developers and the overall permit and approval process. This category can be considerably costly because of the delays that are involved. Categories four and five are land-use regulations designed to either prevent or control growth. Most of the zoning laws that fall under these last two categories have been implemented from the early 1970s onward, and generally in suburban areas of the United States (Quigley & Rosenthal, 2005). An additional category

of taxes on housing not related specifically to zoning includes the various regulations on the sale of previously existing homes such as inspection requirements, and property taxes. These restrictions significantly increase the transaction costs of selling a house and the cost of home ownership.

The origin of zoning laws and land use-restrictions in the United States can be traced to the 19th century (Fischel, 2004). Land-use restrictions of some form have probably existed as far back as human beings have owned land as property and began creating laws to protect property rights. These early land-use restrictions were administered selectively and sparsely in various urban areas to address specific concerns such as fires (Fischel, 2004). Zoning laws as we know them today began in earnest between 1910 and 1920. The difference between the earlier land-use restrictions and the 20th century version was their all-inclusive nature and their preference toward single-family homes (Fischel, 2004). The earlier laws were only for specific areas of a municipality, while the laws that came about after 1910 typically zoned the entire municipality. The reason for this paradigm shift in zoning laws was the adoption of new transportation technologies that shifted the way that people travelled to and from work (Fischel, 2004). Prior to 1880, most people walked to work. Naturally, residential neighborhoods in urban municipalities tended to be close to the industrial areas where people worked. Industry in the cities had to be in close proximity to either the railroads or a port to move raw materials and finished goods. In the 19th century, there were natural limitations for the use of land because of these restrictions. The new forms of public transportation that began to change this were the electric rail car in the 1880s and the motorized bus and truck after 1910 (Cappel, 1991; Fischel, 2004). The electric rail car had the effect of enabling residential neighborhoods to be built further from industrial areas, but did not change the restrictions for the location of industry. Interestingly, the homogeneity of many neighborhoods built during this pre-zoning era before 1910 was strikingly similar to later zoned neighborhoods (Fischel, 2004). One possible explanation is that neighborhoods were typically developed in an orderly fashion around the rail car tracks; another, based on significant evidence, is informal agreements among developers and land owners that ensured that land uses were not mixed (Cappel, 1991).

The incarnation of the motorized bus and truck changed the landscape dramatically. Busses enabled any type of neighborhood (single-family, row houses, apartments, etc.) to be built without the need to be particularly close to the industrial centers where people worked or near to the rail car tracks. The truck had a much more significant impact because it enabled businesses to locate in areas away from the ports and railroads where land was less expensive (Fischel, 2004). The opportunity for commercial enterprises and less desirable apartment and multi-unit housing to freely develop in single-family residential areas is the true origin of 20th century zoning laws (Fischel, 2004). Existing residents' fear of home price devaluation due to commercial or apartment development was the impetus for the new zoning laws. Interestingly, real estate developers of this era initially supported zoning because potential profits for zoned housing developments were higher than for non-zoned developments (Fischel, 2004). Zoning quickly spread from the cities to suburban municipalities during the 1920s. After the landmark U.S. Supreme Court decision in *Village of Euclid vs. Ambler Realty Co* in 1926 that upheld the constitutionality of zoning, it became nearly ubiquitous throughout the United States (Quigley & Rosenthal, 2005; Fischel, 2004). The zoning and land-use regulations that spawned across the United States after the Euclid decision heavily favored single-family homes and largely resulted in the exclusion of low-income residents by restricting the development of higher density housing units (Quigley & Rosenthal, 2005).

Post WWII until the early 1970s gave rise to a massive development of suburban areas around the United States with no significant changes to the types of zoning laws and land-use regulations. However, the early 1970s marked a significant divergence in land-use regulations. Numerous municipalities across the country switched from controlled growth zoning policies to reduced growth and, in certain cases, no-growth policies (Fischel, 2004). Zoning laws aimed at preventing new housing development and population growth of any variety began to be implemented (Quigley & Rosenthal, 2005). According to Fischel (2004), the main driver of these new growth control regulations adopted by suburban municipalities was the completion of the interstate highway system. The interstate highways enabled immense mobility for Americans of all income levels.

Many incumbent homeowners viewed this mobility as a threat and the reaction was the prevention of any new growth in order to prevent the decline of housing prices in existing neighborhoods (Quigley & Rosenthal, 2005). There is no indication that land-use regulations prior to 1970 had any significant impact on the price of housing (Fischel, 2004). This is because of the large number of suburban municipalities that accommodated controlled development prior to 1970. This accommodating attitude quickly shifted across the country to the exclusionary anti-growth zoning regulations that are prevalent today. The result has been a significant decrease nationally in the rate of new house construction and a corresponding increase in price (Glaeser, Gyourko, & Saks, 2005).

## B. ECONOMIC IMPACT OF ZONING LAWS ON HOUSE PRICES

The various forms of zoning regulations all have the same net effect: decreasing supply and increasing the price of housing. This is accomplished in three different ways. The first is by directly restricting the supply of new homes, which results in a shift in the supply curve (see Figure 1). Zoning laws mandating minimum lot sizes and the outright restriction of any development will have this effect. The second method is an increase in the cost to build new houses due to fees and delays (note that this is different than construction costs, which refer to the actual materials and labor to build a house). The zoning regulations that levy fees on developers or delay the issue of permits due to bureaucratic processes tend to have this effect. According to Quigley & Rosenthal (2005), many municipalities apply expensive requirements and standards on potential developers for permit approval. These cost increases and delays act like a tax on housing and shift the supply curve by the amount of the tax (see Figure 1). The third influence these various land-use regulations have on housing supply is a slower response by developers to increases in demand and increased barriers to entry for new developers (Green, Malpezzi, & Mayo, 2005). The net effect is a decrease in the elasticity of the supply curve, resulting in an effective rotation (see Figure 2). All the different types of zoning and land-use restrictions lead to the same outcome: lower equilibrium quantity and higher equilibrium price (Glaeser & Gyourko, 2002). The focus of this paper is on

measuring the shift in the supply curve that results from zoning regulation and the effects on equilibrium P and Q.

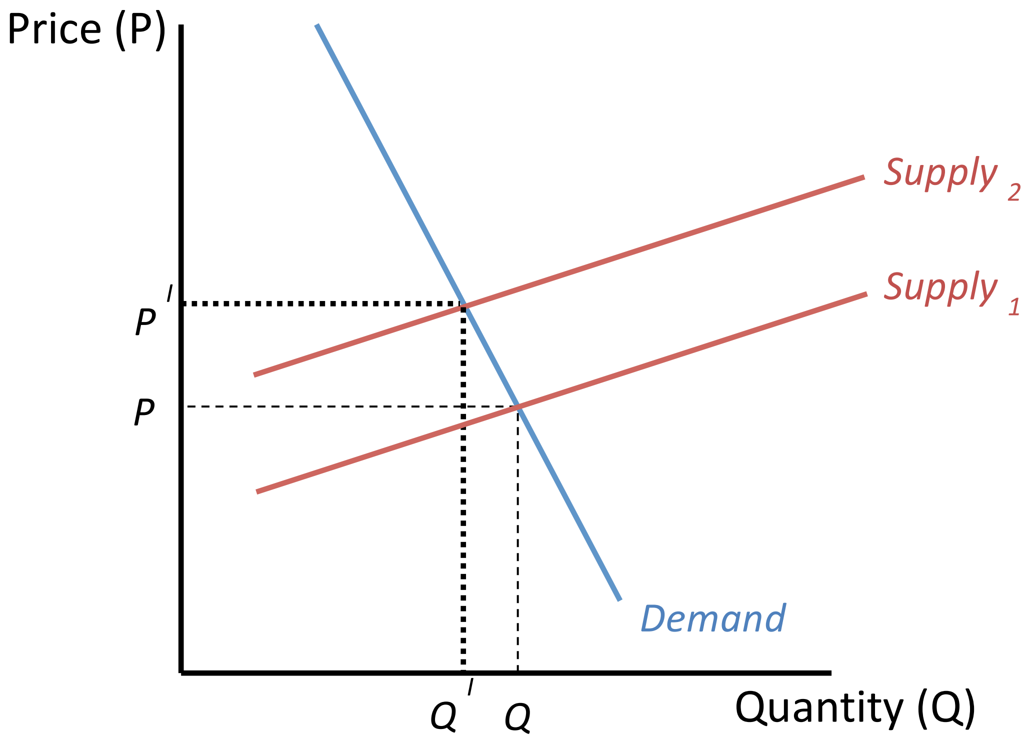


Figure 1. Shift in the Supply Curve from Zoning

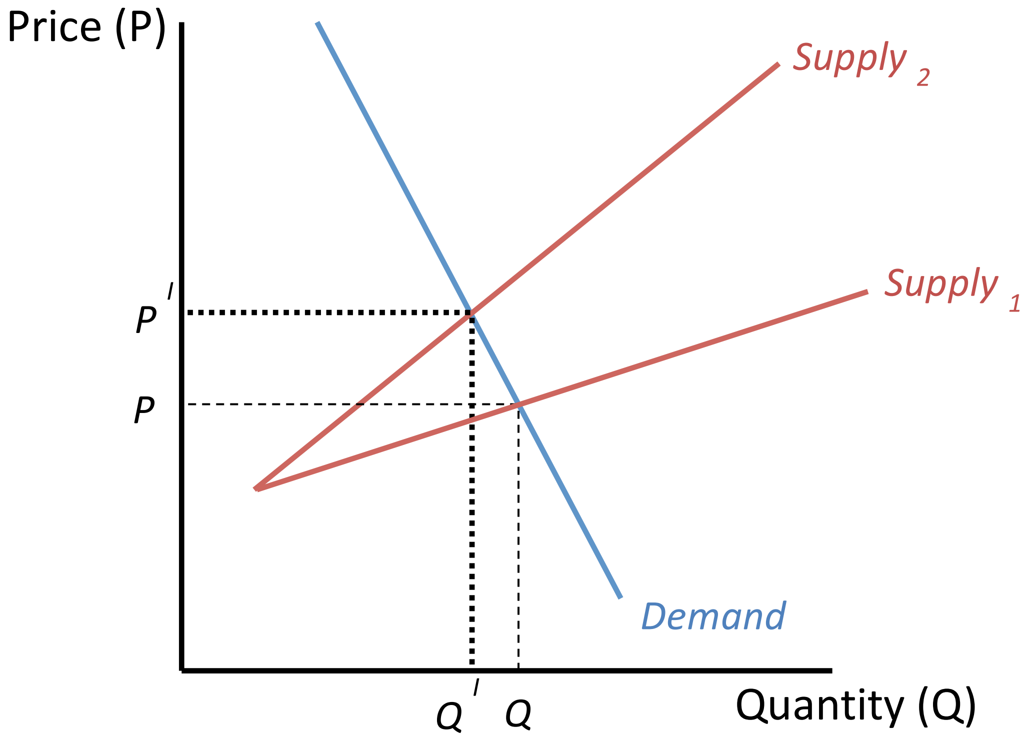


Figure 2. Decrease in Elasticity of the Supply Curve from Zoning

Now that we have established how land-use restrictions affect the supply curve, we can analyze the incidence and the DWL of the zoning tax. The incidence of the effective zoning tax is determined by the price elasticity of supply ($\eta_s$) and the price elasticity of demand ($\eta_d$) for housing.

The long-run price elasticity of demand for housing has received significant study and a fair amount of disagreement due to the multi-dimensional nature of the housing market and the difficulty in obtaining exact sales price data for analysis (Hanushek & Quigley, 1980). Despite this disagreement, there is consensus that housing demand is relatively inelastic, which makes sense because housing is a necessity with a limited number of substitutes. Additionally, housing transaction costs are significant, which reduces consumers' responses to changes in price. Muth (1971) estimates the price elasticity of housing demand to be between -.51 and -.99. Polinsky and Ellwood (1979) estimate price elasticity of housing demand to be between -.56 to -.86, which is relatively close to Muth's estimate. A slightly more inelastic estimate comes from Hanushek and

Quigley (1980), who study housing consumption data of renters from Phoenix and Pittsburgh using two different models. Their simple model yields an estimate for price elasticity of demand between -.33 to -.95 for Pittsburgh and -.20 to -.71 for Phoenix (Hanushek & Quigley, 1980). Due to the significant variation in previous studies, this paper uses 4 different assumptions for the price elasticity of housing demand: -.3, -.5, -.7, and -.9. This captures the reasonable range of estimates from the three studies referenced.

The traditional macroeconomic view is that the long-run supply curve for housing is perfectly elastic (Follain, 1979). Studies by Muth (1960) and Follain (1979) support this hypothesis. However, more recent studies break with this assumption and point toward an elasticity somewhere between 1.5 and 4 (Green, Malpezzi, & Mayo, 2005). Green et al. (2005) report a large variation in the price elasticity for housing supply in 45 metropolitan markets across the country, ranging from .14 in San Francisco to 29.9 in Dallas. Their study shows a statistically significant correlation between price elasticity of supply for housing and the degree of land-use regulation, with the most heavily regulated cities showing the lowest elasticities and the least regulated cities showing the highest elasticities. Only 6 of the 45 cities showed inelastic supply. These findings are significant because they show the amount of influence zoning and other forms of land-use regulation have on the price elasticity of housing supply. The results also make intuitive sense since producers in a market with more stringent land-use regulations should be less able to respond to changes in price. The vast majority of cities in the U.S. have elastic long-run supply curves; however, the degree of elasticity varies considerably depending on the amount of land-use regulation. Many cities with moderate zoning regulations appear to behave as if they have nearly perfectly elastic supply curves (Glaeser, Gyourko, & Saks, 2003). In a few extreme cases such as San Francisco, housing supply appears to be price-inelastic (Green et al., 2005). For simplicity and ease of computation, and because the elasticity is generally very high, this paper makes the assumption of a perfectly elastic supply curve.

A shift in the demand for housing, due, say, to population growth, a change in consumer tastes, or an increased availability of credit, will result in a larger increase in equilibrium price with the lower elasticities seen in the more heavily regulated markets.

A study by Glaeser, Gyourko, and Saiz (2008) yields this exact result. Glaeser et al. (2008) examined the two most recent housing booms from 1982 to 1989 and 1996 to 2006. Their study concludes that during both boom periods, areas with more inelastic housing supply experienced significantly higher price increases than areas with more elastic supply.

This paper focuses on the supply side of the housing market and shifts to the supply curve that result from zoning regulation. However, it is important to note the effect that land-use restrictions have on the price elasticity of housing supply and the impact this has on housing prices when there is an upward shift in the demand curve.

As discussed earlier, the aggregate cost of all zoning restrictions and land-use regulations will be referred to as the zoning "tax". This zoning tax is the amount that the supply curve is shifted as a result of these regulations. The incidence of the zoning tax is determined by the price elasticity of supply and price elasticity of demand. As mentioned earlier, housing demand is relative price-inelastic and the supply of housing is relatively elastic in all but a very few extremely regulated housing markets, San Francisco being the notable example (Green et al., 2005). The result is that a significantly larger share of the zoning tax is borne by buyers (see Figure 3). The portion of the zoning tax borne by buyers is depicted as *a* in Figure 3, while the portion borne by sellers is depicted as *c*. The buyer's portion is many times larger than the seller's portion. Developers pay the majority of the seller's portion of the zoning tax since most zoning regulations are directed toward the development of new construction. The DWL of the zoning tax is depicted as *b+d* in Figure 3. This DWL is a net loss to society. It is the producer and consumer surplus loss from the housing not built due to the zoning tax. The elastic supply curve minimizes the portion of the DWL that is transferred from producer surplus, depicted as *d*. However, the inelastic demand curve results in a much larger portion of the overall DWL being transferred from consumer surplus, depicted as *b*. The result is a much larger amount of consumer surplus lost than producer surplus lost due to zoning regulation.

Interestingly, only a portion of the zoning tax, depicted as *a+c* in Figure 3, is actually collected by the government as tax revenue. This is because a sizeable portion of the shift in the supply curve is due to land being withheld by municipalities for

development and delays to the approval process. So a large portion of the zoning tax can be viewed as a kind of DWL on top of the DWL depicted by $b+d$.

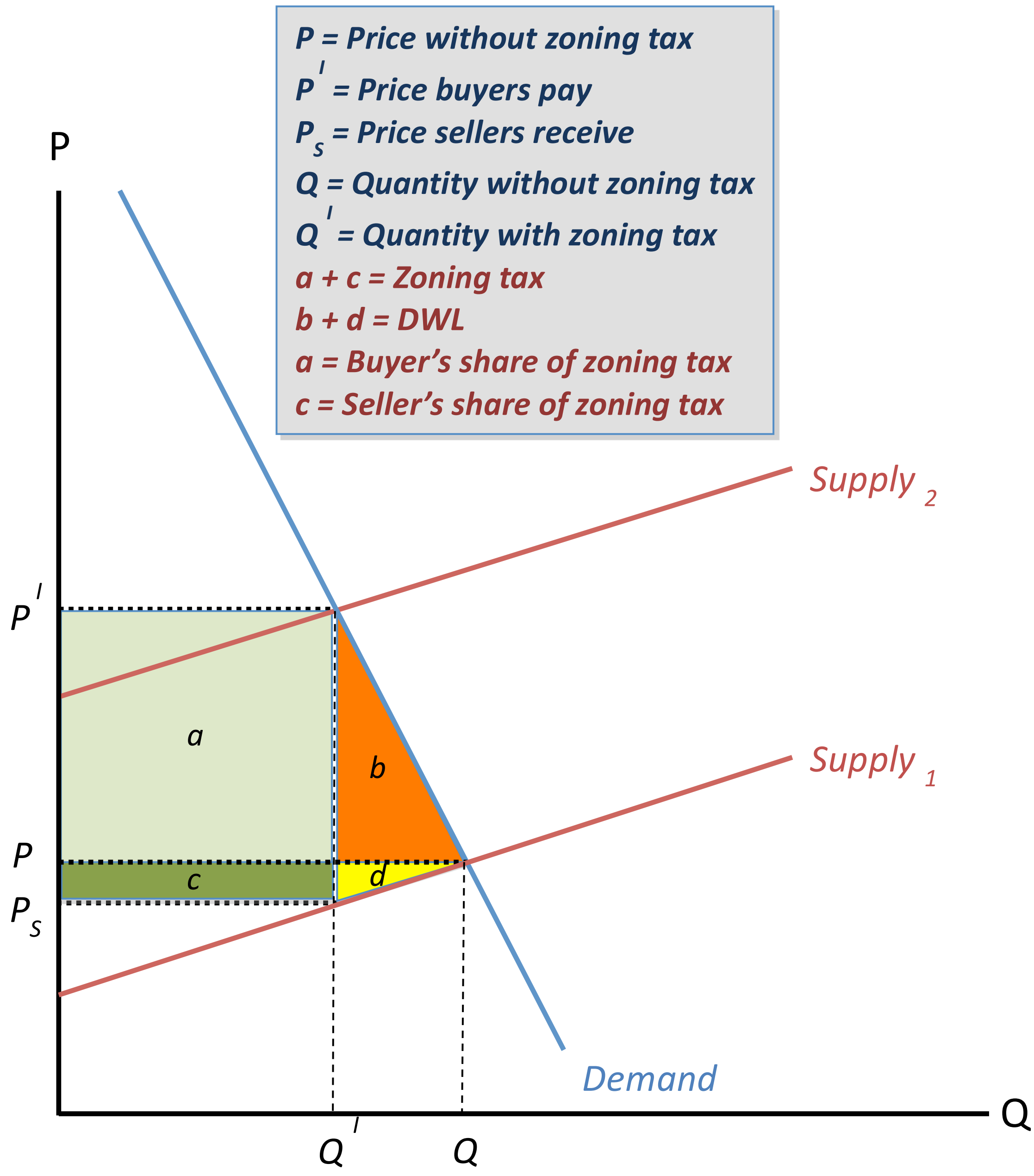


Figure 3. Incidence and DWL of the Zoning Tax

Society as a whole loses due to the DWL created by land-use regulations. The traditional argument in favor of ubiquitous zoning is the need to reduce the negative

externalities caused by unregulated land development (Fischel, 2004). The problem with this argument is that urban conditions in the 19th century were arguably much worse than in the early 20th century. If negative externalities were the true purpose of ubiquitous zoning, it seems that the laws would have been established much earlier (Fischel, 2004).

Undoubtedly, some negative externalities will arise from completely unregulated land development. These external costs are well documented by scholars, including Malpezzi (1996). However, it is unclear what the external costs are in each market and whether land-use regulations are able to shift the supply curve to the socially optimal level. Additionally, there are positive externalities associated with the expansion of housing and homeownership, including increased productivity, employment benefits due to labor mobility, and racial/economic integration (Malpezzi, 1996). Many of the external costs identified by Malpezzi (1996) could be mitigated in other ways that are much more efficient and less costly than blanket land-use restrictions. For example, traffic congestion could be addressed by improving the transportation infrastructure or by using congestion pricing, as opposed to suppressing growth. In order for zoning regulations to achieve the socially optimal quantity, regulators require nearly perfect estimates of the external costs and the imposed regulations must be carefully tailored to prevent restricting supply past the socially optimal level and creating an even worse situation (Malpezzi, 1996). Unfortunately, the political processes that create these regulations are far from perfect and definitive measurements for negative externalities from housing development do not exist.

My belief, for which, admittedly, I do not have overwhelming evidence, is that the external costs of housing development pale in comparison to the DWL imposed on society by the zoning regulations extant in many municipalities across the United States. One of the fundamental advantages of free markets is the efficient transfer of goods from a lower to a higher valued use. This is the reason that both sides gain from free and honest trade. Zoning regulation impedes the transfer undeveloped and under-developed land from a lower valued use to a higher valued use and this is a net loss to society.

On an individual level, the losers from land-use regulation are all non-homeowners, including prospective first time homebuyers and renters, and land developers. First-time homebuyers, without the sale of a previously existing home to help

offset the cost, must pay the bulk of the zoning tax as discussed earlier. Renters are forced to pay higher rents due to the positive correlation between rent and home prices (Davis et al., 2008). Developers as a whole lose due to the reduction in sales from land-use regulations and their share of the zoning tax. Some individual developers may benefit from established political ties with local governments and preferential treatment in the approval process. This results in additional barriers to entry for new competition and the potential for monopoly rents by established developers (Quigley & Rosenthal, 2005). All other industries that feed the housing market, such as building materials suppliers, lose potential sales due to regulation.

The group that gains from zoning regulation is existing homeowners. According to Ellickson (1977), suburban homeowners in some respects are like a cartel, enjoying monopoly rents in their local markets due to the inflated house prices from land-use regulation. This comparison may be extreme, but it helps to highlight what group is the true beneficiary of these regulations at the expense of everyone else. The true purpose of zoning is to inflate the values of existing suburban homes for the benefit of their owners, who happen to be zoning's most fervent supporters (Fischel, 2004). Existing homeowners benefit from zoning regardless of whether they sell their home to realize the increase in value or not. This is because their house is considered an asset at the inflated market price. It can also be rented for a higher price, providing a greater stream of income than would otherwise exist without zoning regulations. Even if they elect to never sell, it will still be passed to their heirs.

## C. ZONING LAWS VERSUS LAND AVAILABILITY

The traditional economic explanation for high-cost housing markets is the scarcity of land. The old saying "they're not making any more land" describes this relationship quite well and represents the common belief about the root cause of high housing prices. However, one needs only to look at large cities around the globe such as New York City or Hong Kong to realize that land availability can become overcome quite easily by building up with multi-unit structures.

Glaeser and Gyourko (2002) show significant evidence that the cost of housing that exceeds physical construction costs in high-priced markets is primarily the result of zoning regulations as opposed to the free market price of land. They do this using three different methods. The first approach, which is the focus of this paper, is to calculate the price of land using two different methodologies and compare the results. They calculate these values for 26 metropolitan areas throughout the United States. Glaeser and Gyourko (2002) conclude that housing prices in the majority of the country are very close to construction costs. A few markets even have prices below construction costs. These rare cases are primarily cities with no growth or declining populations. However, there are a number of areas with housing prices that greatly exceed the price of construction, mostly coastal cities in California and cities in the Northeast.

Glaeser and Gyourko (2002) break down the price of a house into three parts: the physical construction costs in materials and labor to build the structure, the free market price of the land, and the costs associated with obtaining the legal right to build a structure on the land (zoning tax). The first method they use is to calculate what they refer to as the intensive cost of land. They calculate the intensive cost by comparing the value of similar homes with different lot sizes and use the hedonic method to determine the actual free market price of the land per square foot of lot size in the 26 metropolitan areas. This value represents the free market price of land without the legal right to build a structure on it.

Glaeser and Gyourko (2002) then calculate what they refer to as the extensive margin or imputed land cost. They calculate the imputed cost by first calculating the average construction costs for the median size and quality house in each metropolitan area studied. They then subtract the construction cost from the median owner occupied housing price, taken from the 1999 American Housing Survey (AHS). This difference represents the free market price of the land plus the zoning tax. The result is then divided by the average lot size in square feet. This yields the free market price of the land plus the zoning tax, all per square foot. The costs to obtain the legal right to build a structure encompass all of the various zoning and land-use regulations, and will be referred to as the zoning tax referenced earlier. Glaeser and Gyourko's (2002) imputed cost, which is

the price of land plus the zoning tax, compared to the intensive cost, which is the free market price of the land, shows the cost of housing above construction costs that is from zoning regulation versus the amount from the scarcity of land.

To clarify, consider a simple hypothetical example. Assume that the price of a house and the land it is on is $100,000. Assume also that the construction cost is $40,000. The remaining $60,000 represents the free market cost of the land plus the zoning tax. This is Glaeser and Gyourko's imputed cost. Assume that their estimate of the free-market value of land, which they call the intensive cost, equals $10,000. In that case, the zoning tax is $60,000 minus $10,000, which is $50,000.

Their estimates show that the zoning tax is much larger than the free market price of land, with an average ratio of approximately 10 to 1. This means that the zoning tax on average makes up approximately 90% of the housing costs that are above physical construction costs. Theoretically, the imputed cost and the intensive cost should be the same in a perfectly free unregulated market because the zoning tax would be zero. Glaeser and Gyourko's (2002) estimates are summarized in Table 1.

Table 1. Intensive versus Imputed Cost of Land in 26 Metropolitan Areas (from Glaeser & Gyourko, 2002)

| **Metropolitan Area** | **Median House Price (1999 AHS)** | **Free Market Cost of Land per sq. ft. (Intensive Cost)** | **Cost of Land + Zoning "Tax" per sq. ft. (Imputed Cost)** |
|---|---|---|---|
| **Anaheim** | $312,312 | $2.89 | $38.99 |
| **Atlanta** | $150,027 | $0.23 | $3.20 |
| **Baltimore** | $152,813 | $1.15 | $4.43 |
| **Boston** | $250,897 | $0.07 | $13.16 |
| **Chicago** | $184,249 | $0.79 | $14.57 |
| **Cincinnati** | $114,083 | $0.89 | $2.71 |
| **Cleveland** | $128,127 | $0.26 | $4.13 |
| **Dallas** | $117,805 | $0.21 | $5.42 |
| **Detroit** | $138,217 | $0.14 | $5.10 |
| **Houston** | $108,463 | $1.43 | $4.37 |
| **Kansas City** | $112,700 | $2.06 | $1.92 |
| **Los Angeles** | $254,221 | $2.19 | $30.44 |

| Metropolitan Area | Median House Price (1999 AHS) | Free Market Cost of Land per sq. ft. (Intensive Cost) | Cost of Land + Zoning "Tax" per sq. ft. (Imputed Cost) |
|---|---|---|---|
| **Miami** | $153,041 | $0.37 | $10.87 |
| **Milwaukee** | $130,451 | $1.44 | $3.04 |
| **Minneapolis** | $149,267 | $0.29 | $8.81 |
| **New York City** | $252,743 | $0.84 | $32.33 |
| **Newark** | $231,312 | $0.42 | $17.70 |
| **Philadelphia** | $163,615 | $1.07 | $3.20 |
| **Phoenix** | $143,296 | $1.89 | $6.86 |
| **Pittsburgh** | $106,747 | $2.28 | $3.08 |
| **Riverside** | $149,819 | $1.35 | $7.92 |
| **San Diego** | $245,764 | $0.58 | $26.12 |
| **San Francisco** | $461,209 | $0.97 | $63.72 |
| **Seattle** | $262,676 | $0.48 | $18.91 |
| **St. Louis** | $110,335 | $0.63 | $1.74 |
| **Tampa** | $101,593 | $0.19 | $6.32 |

The second approach used by Glaeser and Gyourko (2002) is to look at population density and test for a correlation between density and housing prices. The traditional theory that land scarcity is the driving factor behind high housing prices would imply that areas with higher population density have higher-cost housing. But Glaeser and Gyourko (2002) find no significant correlation between housing prices and population density. The final approach they use is a linear regression of housing prices on a measure of the degree of zoning regulation. They find a significant positive correlation between these two variables. That is, the more stringent the zoning regulations, the higher the housing costs (Glaeser & Gyourko, 2002). These last two tests strengthen the hypothesis that zoning regulation is the primary driver of high housing costs.

# III. ANALYSIS

## A. CALCULATION OF P WITHOUT ZONING TAX

There is obviously no direct method to measure what the equilibrium price without zoning regulation (P) would be in different metropolitan areas. Therefore, it is necessary to take an indirect approach to derive P. The method chosen for this paper is to use the data from Glaeser and Gyourko (2002) to estimate the percentage of the median house price that is a result of zoning regulation and subtracting that percentage from the median home value from the 2012 ACS to derive P. Due to limitations of the metropolitan areas studied in the 2012 ACS vs. the 1999 AHS, only 25 of the 26 metropolitan areas studied by Glaeser and Gyourko (2002) can be analyzed. Anaheim is the area omitted. The price and quantity data from both the ACS and the AHS are for owner occupied housing.

The first step it to quantify the data for the 25 metropolitan areas from Glaeser and Gyourko (2002) in Table 1. Their estimate for the free market price of land per sq. ft. is in column 3 of Table 1. Column 4 contains their estimate for the free market price of land + the zoning tax per sq. ft. The difference between these two columns yields the zoning tax per sq. ft., which is displayed in column 3 of Table 2.

The proportion of the cost of housing exceeding construction costs (CC) that can be attributed to zoning is the *zoning tax ratio* (column 4, Table 2). This is calculated by dividing the (zoning tax per sq. ft.) by (the free market price of land + the zoning tax per sq. ft.). Note that the zoning tax ratio for Kansas City is negative. This is likely due to the statistical variation from the Glaeser and Gyourko (2002) calculations for imputed and intensive values of land. This simply shows that the imputed and intensive land values are nearly the same because either the zoning tax in Kansas City is extremely low, or the city has no growth.

The actual cost of housing exceeding construction costs (P-CC) is not displayed by Glaeser and Gyourko (2002). This value must be derived. After this calculation is

made, the zoning tax ratio can then be applied to (P – CC) to arrive at the *implicit zoning tax percentage* for each metropolitan area.

In Glaeser and Gyourko's (2002) original calculations for the intensive and imputed costs of land (see Table 1), they use the average residential construction cost per sq. ft. of house size from the R.S. Means Company for each metropolitan area. Unfortunately, they don't list these values in their article and the original source was unavailable. The values cannot be derived because the imputed cost calculation is per sq. ft. of average lot size for each market studied, and the average lot size is also not listed. However, they do list the mean value for the construction cost of an economy home, which their calculations are based upon. This mean value is $60 per sq. ft., representing the average material and labor cost for residential construction. Obviously, this cost will vary from city to city. However, Glaeser and Gyourko (2002) indicate that the variation is not significant. Fortunately I was able to find data from a later study by Glaeser, Gyourko, and Saiz (2008), which lists construction costs for all 25 metropolitan areas in this study. These values were compared to the mean construction cost for all metropolitan areas to calculate the percent variation above or below the mean. This percentage for each metropolitan area was then applied to the average construction cost of $60 per sq. ft. to adjust the construction costs appropriately. I recognize that this is not the ideal method to calculate the original construction costs due to the potential differences in costs over time between the two studies. However, the time period is relatively short and the variation in residential construction costs across the United States is fairly small, as indicated by Glaeser and Gyourko (2002) and shown in their (2008) study, with a standard deviation of only $20,032 in total costs across the entire country. Any errors that result from the indirect calculation of construction costs should be minimal.[1]

The adjusted construction costs per sq. ft. are displayed in column 5 of Table 2. The variation between metropolitan areas is relatively small, with a mean of $63.92 per

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[1] The original source from the R.S. Means Company used by Glaeser and Gyourko (2002) became available to the author after calculations for this paper were made. Construction costs calculated using the newly acquired R.S. Means data were very close to the author's original indirect calculations, with the former tending to be slightly lower in value. Therefore, the decision was made to use the original construction cost calculations as they provide a more conservative estimate.

sq. ft. and a standard deviation of $6.99. New York is the only clear outlier, with construction costs more than two standard deviations larger than the mean.

Table 2. Zoning Tax Ratio and CC / sq. ft.

| Metropolitan Area | Median House Price (1999 AHS) | Zoning Tax (per sq. ft.) | Zoning Tax Ratio | Construction Cost (CC) 1999 (per sq. ft.) |
|---|---|---|---|---|
| **Atlanta** | $150,027 | $2.97 | 92.81% | $55.71 |
| **Baltimore** | $152,813 | $3.28 | 74.04% | $57.41 |
| **Boston** | $250,897 | $13.09 | 99.47% | $72.20 |
| **Chicago** | $184,249 | $13.78 | 94.58% | $70.20 |
| **Cincinnati** | $114,083 | $1.82 | 67.16% | $57.37 |
| **Cleveland** | $128,127 | $3.87 | 93.70% | $62.07 |
| **Dallas** | $117,805 | $5.21 | 96.13% | $52.17 |
| **Detroit** | $138,217 | $4.96 | 97.25% | $65.08 |
| **Houston** | $108,463 | $2.94 | 67.28% | $54.96 |
| **Kansas City** | $112,700 | $(0.14) | -7.29% | $63.62 |
| **Los Angeles** | $254,221 | $28.25 | 92.81% | $66.82 |
| **Miami** | $153,041 | $10.50 | 96.60% | $56.05 |
| **Milwaukee** | $130,451 | $1.60 | 52.63% | $63.58 |
| **Minneapolis** | $149,267 | $8.52 | 96.71% | $69.45 |
| **New York** | $252,743 | $31.49 | 97.40% | $81.01 |
| **Newark** | $231,312 | $17.28 | 97.63% | $69.71 |
| **Philadelphia** | $163,615 | $2.13 | 66.56% | $70.92 |
| **Phoenix** | $143,296 | $4.97 | 72.45% | $55.60 |
| **Pittsburgh** | $106,747 | $0.80 | 25.97% | $61.43 |
| **Riverside** | $149,819 | $6.57 | 82.95% | $65.76 |
| **San Diego** | $245,764 | $25.54 | 97.78% | $65.35 |
| **San Francisco** | $461,209 | $62.75 | 98.48% | $75.70 |
| **Seattle** | $262,676 | $18.43 | 97.46% | $64.52 |
| **St. Louis** | $110,335 | $1.11 | 63.79% | $64.22 |
| **Tampa** | $101,593 | $6.13 | 96.99% | $57.22 |

Actual construction costs for each metropolitan area are calculated by multiplying the adjusted CC per sq. ft. by the median sized house from the 1999 AHS. The 1999 AHS lists the median house size as 1704 sq. ft. The results are in column 3 of Table 3.

The calculated construction cost for a 1704 sq. ft. house is subtracted from the median house price from the 1999 AHS to derive (P-CC), displayed in column 4 of Table 3. As expected, there is significant variation in the (P-CC) values. They range from just under $1,000 in St. Louis to over $300,000 in San Francisco.

The implicit zoning tax percentage is calculated by first multiplying (P-CC) by the zoning tax ratio from Table 2. This value is then divided by median house price from the 1999 AHS. The result is the implicit zoning tax percentage displayed in column 5 of Table 3. The implicit zoning tax percentage represents the estimated portion of the median house price from the 1999 AHS that is the zoning tax, based on the original calculations by Glaeser and Gyourko (2002).

Table 3. Implicit Zoning Tax Percentage

| Metropolitan Area | Median House Price (1999 AHS) | Construction Cost (1704 sq. ft. House) | Price – CC (P-CC) | Implicit Zoning Tax Percentage |
|---|---|---|---|---|
| **Atlanta** | $150,027 | $94,932 | $55,095 | 34.08% |
| **Baltimore** | $152,813 | $97,818 | $54,995 | 26.65% |
| **Boston** | $250,897 | $123,026 | $127,871 | 50.69% |
| **Chicago** | $184,249 | $119,627 | $64,622 | 33.17% |
| **Cincinnati** | $114,083 | $97,754 | $16,329 | 9.61% |
| **Cleveland** | $128,127 | $105,772 | $22,355 | 16.35% |
| **Dallas** | $117,805 | $88,902 | $28,903 | 23.58% |
| **Detroit** | $138,217 | $110,903 | $27,314 | 19.22% |
| **Houston** | $108,463 | $93,649 | $14,814 | 9.19% |
| **Kansas City** | $112,700 | $108,402 | $4,298 | -0.28% |
| **Los Angeles** | $254,221 | $113,854 | $140,367 | 51.24% |
| **Miami** | $153,041 | $95,509 | $57,532 | 36.31% |
| **Milwaukee** | $130,451 | $108,338 | $22,113 | 8.92% |
| **Minneapolis** | $149,267 | $118,344 | $30,923 | 20.03% |
| **New York** | $252,743 | $138,036 | $114,707 | 44.21% |
| **Newark** | $231,312 | $118,793 | $112,519 | 47.49% |
| **Philadelphia** | $163,615 | $120,846 | $42,769 | 17.40% |
| **Phoenix** | $143,296 | $94,740 | $48,556 | 24.55% |
| **Pittsburgh** | $106,747 | $104,682 | $2,065 | 0.50% |

| Metropolitan Area | Median House Price (1999 AHS) | Construction Cost (1704 sq. ft. House) | Price – CC (P-CC) | Implicit Zoning Tax Percentage |
|---|---|---|---|---|
| **Riverside** | $149,819 | $112,058 | $37,761 | 20.91% |
| **San Diego** | $245,764 | $111,353 | $134,411 | 53.48% |
| **San Francisco** | $461,209 | $128,992 | $332,217 | 70.94% |
| **Seattle** | $262,676 | $109,941 | $152,735 | 56.67% |
| **St. Louis** | $110,335 | $109,428 | $907 | 0.52% |
| **Tampa** | $101,593 | $97,497 | $4,096 | 3.91% |

The final step in calculating the equilibrium price without zoning regulation (P) is to apply the implicit zoning tax percentage to the median house price from the 2012 ACS. The 2012 ACS median house price is the equilibrium price with zoning regulation ($P^I$). The implicit zoning tax percentage multiplied by $P^I$ yields the price of the zoning tax. Subtracting this value from $P^I$ results in the estimated equilibrium price with a 100% reduction in the zoning tax (P). P is displayed in Column 3 of Table 4.

The estimated price reduction shown in Table 4 is nothing short of remarkable. The thought of a $209,000 median house price in the San Francisco metropolitan area is almost unimaginable. These figures show the sad reality of the regulatory regime in many of these high cost areas. The artificial restrictions on supply that are keeping house prices elevated to the benefit of incumbent homeowners at the expense of renters and potential buyers is unfortunate.

Eliminating government regulation has historically been a challenging endeavor. The feasibility of a complete elimination of land-use restrictions in many municipalities is quite low. However, a realistic estimate of what house prices would look like without zoning is a valuable statistic because it puts a real dollar value on the significant costs that zoning regulations impose. For proponents of housing affordability, these estimates can be used to guide efforts to make housing more affordable by reducing government regulation. Estimates of equilibrium price for a 75% reduction ($P_{75}$) and a 50% reduction ($P_{50}$) in zoning regulation have also been calculated by adjusting the implicit zoning tax percentage accordingly. These values are in columns 4 and 5 of Table 4, respectively. This gives a realistic range for potential price reductions that are in line with feasible

land-use reform efforts. Complete elimination of the zoning tax may be impractical, but a 50 percent reduction may be possible and the effect is still significant, especially in the very high-cost markets as seen in Table 4. Zoning regulations such as permit fees, mandatory waiting periods, and moratorium on development could be partially reduced. The estimated equilibrium price for any percentage of zoning reduction can be calculated by adjusting implicit zoning tax percentage.

Table 4. Equilibrium Price without the Zoning Tax (P)

| Metropolitan Area | Median House Price (2012 ACS) ($P^I$) | Price with 100% Zoning Tax Reduction (P) | Price with 75% Zoning Tax Reduction ($P_{75}$) | Price with 50% Zoning Tax Reduction ($P_{50}$) |
|---|---|---|---|---|
| **Atlanta** | $160,800 | $105,993 | $119,695 | $133,397 |
| **Baltimore** | $271,100 | $198,863 | $216,922 | $234,981 |
| **Boston** | $356,500 | $175,775 | $220,956 | $266,137 |
| **Chicago** | $215,100 | $143,748 | $161,586 | $179,424 |
| **Cincinnati** | $151,800 | $137,208 | $140,856 | $144,504 |
| **Cleveland** | $139,400 | $116,609 | $122,307 | $128,005 |
| **Dallas** | $158,200 | $120,890 | $130,218 | $139,545 |
| **Detroit** | $77,200 | $62,363 | $66,072 | $69,782 |
| **Houston** | $141,400 | $128,407 | $131,655 | $134,904 |
| **Kansas City** | $156,000 | $156,434 | $156,325 | $156,217 |
| **Los Angeles** | $399,500 | $194,788 | $245,966 | $297,144 |
| **Miami** | $181,500 | $115,592 | $132,069 | $148,546 |
| **Milwaukee** | $192,900 | $175,690 | $179,993 | $184,295 |
| **Minneapolis** | $203,700 | $162,890 | $173,092 | $183,295 |
| **New York** | $450,300 | $251,242 | $301,007 | $350,771 |
| **Newark** | $356,700 | $187,305 | $229,654 | $272,003 |
| **Philadelphia** | $244,000 | $201,545 | $212,159 | $222,773 |
| **Phoenix** | $156,100 | $117,778 | $127,359 | $136,939 |
| **Pittsburgh** | $124,300 | $123,675 | $123,832 | $123,988 |
| **Riverside** | $214,100 | $169,336 | $180,527 | $191,718 |
| **San Diego** | $386,400 | $179,766 | $231,424 | $283,083 |
| **San Francisco** | $719,800 | $209,208 | $336,856 | $464,504 |
| **Seattle** | $325,200 | $140,910 | $186,982 | $233,055 |
| **St. Louis** | $155,200 | $154,386 | $154,590 | $154,793 |
| **Tampa** | $132,400 | $127,223 | $128,517 | $129,812 |

## B. CALCULATION OF Q WITHOUT ZONING TAX

In order to calculate the equilibrium quantity supplied without zoning (Q) it is necessary to know the price elasticity of housing demand ($\eta_d$). As discussed earlier, a range of estimates will be used based on multiple studies on the subject. The values used are -.3, -.5, -.7, and -.9. Q will vary depending on the $\eta_d$ assumption. The equilibrium quantity supplied with zoning ($Q^I$) and the equilibrium price with zoning ($P^I$) are from the 2012 ACS. The estimates for P at various levels of zoning reduction are summarized in Table 4. Estimates for Q are calculated for a 100%, 75%, and 50% reduction to the zoning tax at each $\eta_d$ value.

The price elasticity of demand ($\eta_d$) is defined as the percent change in quantity divided by the percent change in price (Equation 1).

$$\eta_d = \frac{\%\Delta Q}{\%\Delta P} \qquad (1)$$

This equation can be expanded, where $\Delta Q$ is the difference between Q and $Q^I$ and $\Delta P$ is the difference between P and $P^I$ (Equation 2).

$$\eta_d = \frac{(Q - Q^I)/[(Q + Q^I)/2]}{(P - P^I)/[(P + P^I)/2]} \qquad (2)$$

Equation 2 can be simplified to:

$$\eta_d = \frac{(Q - Q^I)/(Q + Q^I)}{(P - P^I)/(P + P^I)} \qquad (3)$$

Both P and $P^I$ are known values; therefore the denominator of Equation 3 can be called $\alpha$.

$$\eta_d = \frac{(Q - Q^I)/(Q + Q^I)}{\alpha} \qquad (4)$$

Solving for Q yields the equation used to calculate equilibrium quantity supplied without zoning (Q) (Equation 5).

$$Q = \frac{(\eta_d \alpha Q^I) + Q^I}{(1 - \eta_d \alpha)} \qquad (5)$$

The estimates for Q at the three levels of zoning reduction for each $\eta_d$ value are displayed in Tables 5-8. Q increases with a reduction in the zoning tax due to the shift in the supply curve (see Figure 3). As expected, metropolitan areas where the zoning tax is

small have negligible increases in Q, corresponding to small reductions in P. Areas with a larger zoning tax, such as San Francisco or Boston, see large increases to Q when the tax is reduced. This additional supply is the effect of reducing or eliminating zoning regulation. The increase to Q results in a lower equilibrium price (P). Notice that as $\eta_d$ increases, representing an increase in elasticity of the demand curve, the increase in Q from zoning reduction becomes larger. The range of estimates for Q is necessary because a definitive value for $\eta_d$ is unknown. The estimates vary significantly. It is also likely that $\eta_d$ is different in each metropolitan area.

It is possible that some cities have significant zoning regulations in place but still have a low calculated implicit zoning tax percentage due to a lack of demand as a result of no population growth. The zoning regulations are essentially non-binding in these instances.

It should be noted that such a significant increase in quantity supplied and the corresponding reduction in housing prices from zoning deregulation will certainly hurt incumbent homeowners, landlords, and owners of apartments. This is especially true in high-cost housing markets. However, many apartment renters, home renters, and people living with family or roommates will be able to afford to own a house and this is undoubtedly a benefit to society. Reforms to land-use restrictions must happen over a period of time to allow the market and individuals to adjust.

Table 5. Equilibrium Quantity without Zoning Tax (Q) [$\eta_d = -.3$]

| Metropolitan Area [$\eta_d = -.3$] | Quantity w/ Zoning (2012 ACS) ($Q^I$) | Quantity w/ 100% Zoning Tax Reduction (Q) | Quantity w/ 75% Zoning Tax Reduction ($Q_{75}$) | Quantity w/ 50% Zoning Tax Reduction ($Q_{50}$) |
|---|---|---|---|---|
| **Atlanta** | 1,227,569 | 1,388,813 | 1,340,469 | 1,298,148 |
| **Baltimore** | 681,857 | 747,781 | 728,840 | 711,694 |
| **Boston** | 419,455 | 514,598 | 483,004 | 457,643 |
| **Chicago** | 1,814,279 | 2,044,455 | 1,975,810 | 1,915,460 |
| **Cincinnati** | 548,390 | 565,258 | 560,834 | 556,552 |
| **Cleveland** | 547,601 | 577,653 | 569,489 | 561,784 |
| **Dallas** | 904,726 | 980,326 | 958,971 | 939,388 |
| **Detroit** | 415,753 | 443,146 | 435,590 | 428,537 |
| **Houston** | 1,288,302 | 1,326,071 | 1,316,186 | 1,306,605 |
| **Kansas City** | 527,391 | 526,952 | 527,061 | 527,171 |
| **Los Angeles** | 1,481,122 | 1,822,520 | 1,708,750 | 1,617,713 |
| **Miami** | 455,142 | 520,044 | 500,328 | 483,251 |
| **Milwaukee** | 373,765 | 384,385 | 381,609 | 378,916 |
| **Minneapolis** | 900,327 | 962,542 | 945,305 | 929,268 |
| **New York** | 1,670,606 | 1,981,482 | 1,882,414 | 1,799,966 |
| **Newark** | 474,406 | 572,172 | 540,368 | 514,368 |
| **Philadelphia** | 984,992 | 1,042,964 | 1,027,128 | 1,012,241 |
| **Phoenix** | 954,941 | 1,038,625 | 1,014,860 | 993,155 |
| **Pittsburgh** | 688,195 | 689,236 | 688,975 | 688,715 |
| **Riverside** | 802,224 | 860,457 | 844,247 | 829,218 |
| **San Diego** | 573,530 | 714,565 | 666,873 | 629,214 |
| **San Francisco** | 337,415 | 470,651 | 419,735 | 384,074 |
| **Seattle** | 636,078 | 807,280 | 748,142 | 702,354 |
| **St. Louis** | 772,434 | 773,653 | 773,348 | 773,043 |
| **Tampa** | 727,671 | 736,429 | 734,197 | 731,994 |

Table 6. Equilibrium Quantity without Zoning Tax (Q) [$\eta_d$ = -.5]

| Metropolitan Area [$\eta_d$ = -.5] | Quantity w/ Zoning (2012 ACS) ($Q^I$) | Quantity w/ 100% Zoning Tax Reduction (Q) | Quantity w/ 75% Zoning Tax Reduction ($Q_{75}$) | Quantity w/ 50% Zoning Tax Reduction ($Q_{50}$) |
|---|---|---|---|---|
| **Atlanta** | 1,227,569 | 1,508,614 | 1,421,687 | 1,347,498 |
| **Baltimore** | 681,857 | 795,389 | 762,002 | 732,321 |
| **Boston** | 419,455 | 590,996 | 531,003 | 485,093 |
| **Chicago** | 1,814,279 | 2,214,845 | 2,091,732 | 1,986,109 |
| **Cincinnati** | 548,390 | 576,794 | 569,287 | 562,061 |
| **Cleveland** | 547,601 | 598,621 | 584,574 | 571,445 |
| **Dallas** | 904,726 | 1,034,336 | 996,977 | 963,244 |
| **Detroit** | 415,753 | 462,433 | 449,349 | 437,280 |
| **Houston** | 1,288,302 | 1,351,872 | 1,335,114 | 1,318,953 |
| **Kansas City** | 527,391 | 526,659 | 526,842 | 527,025 |
| **Los Angeles** | 1,481,122 | 2,097,475 | 1,880,987 | 1,715,994 |
| **Miami** | 455,142 | 568,709 | 533,030 | 502,974 |
| **Milwaukee** | 373,765 | 391,634 | 386,930 | 382,390 |
| **Minneapolis** | 900,327 | 1,006,463 | 976,559 | 949,084 |
| **New York** | 1,670,606 | 2,222,997 | 2,039,196 | 1,891,918 |
| **Newark** | 474,406 | 649,369 | 589,685 | 542,933 |
| **Philadelphia** | 984,992 | 1,083,545 | 1,056,234 | 1,030,829 |
| **Phoenix** | 954,941 | 1,098,611 | 1,056,939 | 1,019,492 |
| **Pittsburgh** | 688,195 | 689,931 | 689,495 | 689,061 |
| **Riverside** | 802,224 | 901,686 | 873,506 | 847,724 |
| **San Diego** | 573,530 | 829,577 | 738,026 | 669,440 |
| **San Francisco** | 337,415 | 593,135 | 486,760 | 418,937 |
| **Seattle** | 636,078 | 949,538 | 834,504 | 750,513 |
| **St. Louis** | 772,434 | 774,467 | 773,957 | 773,449 |
| **Tampa** | 727,671 | 742,327 | 738,581 | 734,890 |

Table 7. Equilibrium Quantity without Zoning Tax (Q) [$\eta_d$ = -.7]

| Metropolitan Area [$\eta_d$ = -.7] | Quantity w/ Zoning (2012 ACS) ($Q^I$) | Quantity w/ 100% Zoning Tax Reduction (Q) | Quantity w/ 75% Zoning Tax Reduction ($Q_{75}$) | Quantity w/ 50% Zoning Tax Reduction ($Q_{50}$) |
|---|---|---|---|---|
| **Atlanta** | 1,227,569 | 1,639,912 | 1,508,209 | 1,398,816 |
| **Baltimore** | 681,857 | 846,278 | 796,761 | 753,569 |
| **Boston** | 419,455 | 681,005 | 584,396 | 514,317 |
| **Chicago** | 1,814,279 | 2,400,978 | 2,214,968 | 2,059,485 |
| **Cincinnati** | 548,390 | 588,573 | 577,871 | 567,626 |
| **Cleveland** | 547,601 | 620,385 | 600,072 | 581,276 |
| **Dallas** | 904,726 | 1,091,532 | 1,036,567 | 987,724 |
| **Detroit** | 415,753 | 482,606 | 463,559 | 446,206 |
| **Houston** | 1,288,302 | 1,378,188 | 1,354,318 | 1,331,418 |
| **Kansas City** | 527,391 | 526,367 | 526,622 | 526,878 |
| **Los Angeles** | 1,481,122 | 2,422,353 | 2,072,885 | 1,820,713 |
| **Miami** | 455,142 | 622,488 | 568,049 | 523,545 |
| **Milwaukee** | 373,765 | 399,023 | 392,327 | 385,896 |
| **Minneapolis** | 900,327 | 1,052,505 | 1,008,890 | 969,334 |
| **New York** | 1,670,606 | 2,498,717 | 2,210,454 | 1,988,876 |
| **Newark** | 474,406 | 738,861 | 644,041 | 573,198 |
| **Philadelphia** | 984,992 | 1,125,784 | 1,086,194 | 1,049,767 |
| **Phoenix** | 954,941 | 1,162,318 | 1,100,855 | 1,046,551 |
| **Pittsburgh** | 688,195 | 690,626 | 690,016 | 689,408 |
| **Riverside** | 802,224 | 945,011 | 903,825 | 866,655 |
| **San Diego** | 573,530 | 967,141 | 817,839 | 712,450 |
| **San Francisco** | 337,415 | 759,383 | 566,805 | 457,341 |
| **Seattle** | 636,078 | 1,122,903 | 932,359 | 802,266 |
| **St. Louis** | 772,434 | 775,282 | 774,567 | 773,855 |
| **Tampa** | 727,671 | 748,273 | 742,991 | 737,798 |

Table 8. Equilibrium Quantity without Zoning Tax (Q) [$\eta_d = -.9$]

| **Metropolitan Area [$\eta_d = -.9$]** | **Quantity w/ Zoning (2012 ACS) ($Q^I$)** | **Quantity w/ 100% Zoning Tax Reduction (Q)** | **Quantity w/ 75% Zoning Tax Reduction ($Q_{75}$)** | **Quantity w/ 50% Zoning Tax Reduction ($Q_{50}$)** |
|---|---|---|---|---|
| **Atlanta** | 1,227,569 | 1,784,447 | 1,600,574 | 1,452,221 |
| **Baltimore** | 681,857 | 900,797 | 833,235 | 775,464 |
| **Boston** | 419,455 | 788,618 | 644,143 | 545,492 |
| **Chicago** | 1,814,279 | 2,605,142 | 2,346,234 | 2,135,751 |
| **Cincinnati** | 548,390 | 600,600 | 586,588 | 573,246 |
| **Cleveland** | 547,601 | 642,992 | 616,000 | 591,281 |
| **Dallas** | 904,726 | 1,152,205 | 1,077,839 | 1,012,855 |
| **Detroit** | 415,753 | 503,728 | 478,245 | 455,322 |
| **Houston** | 1,288,302 | 1,405,033 | 1,373,805 | 1,344,004 |
| **Kansas City** | 527,391 | 526,075 | 526,403 | 526,732 |
| **Los Angeles** | 1,481,122 | 2,812,108 | 2,288,015 | 1,932,524 |
| **Miami** | 455,142 | 682,228 | 605,642 | 545,018 |
| **Milwaukee** | 373,765 | 406,556 | 397,802 | 389,435 |
| **Minneapolis** | 900,327 | 1,100,826 | 1,042,355 | 990,033 |
| **New York** | 1,670,606 | 2,816,462 | 2,398,288 | 2,091,258 |
| **Newark** | 474,406 | 843,839 | 704,249 | 605,318 |
| **Philadelphia** | 984,992 | 1,169,783 | 1,117,048 | 1,069,063 |
| **Phoenix** | 954,941 | 1,230,105 | 1,146,731 | 1,074,362 |
| **Pittsburgh** | 688,195 | 691,322 | 690,538 | 689,755 |
| **Riverside** | 802,224 | 990,597 | 935,260 | 886,025 |
| **San Diego** | 573,530 | 1,134,610 | 907,995 | 758,544 |
| **San Francisco** | 337,415 | 997,954 | 664,069 | 499,853 |
| **Seattle** | 636,078 | 1,338,832 | 1,044,165 | 858,033 |
| **St. Louis** | 772,434 | 776,097 | 775,178 | 774,261 |
| **Tampa** | 727,671 | 754,266 | 747,427 | 740,717 |

## C. CALCULATION OF DWL AND ZONING TAX

The DWL caused by the zoning tax for each metropolitan area is calculated for a $\eta_d$ of -.5. Refer to Figure 3 for a graphical depiction of DWL caused by zoning regulation. Glaeser and Gyourko (2002) assume an infinite price elasticity of supply in their original calculations of the intensive and imputed cost of land. The same assumption is adopted in this paper in order to maintain consistency and because the assumption of a perfectly elastic supply curve is close to being accurate and makes computation much easier. Green et al. (2005) show that the vast majority of markets in the U.S. have a relatively high price elasticity supply, with 30 of the 45 markets in their study having values greater than 4. There are a few markets where this assumption is not ideal, most notably San Francisco, which actually shows evidence of a slightly inelastic housing supply curve. However, the assumption is appropriate for the preponderance of markets studied. The DWL for each metropolitan area is calculated using Equation 6.

$$DWL = \frac{1}{2}[(P^I - P)(Q - Q^I)] \tag{6}$$

The values for DWL are displayed in column 2 of Table 9. This DWL represents the loss to society that is a result of zoning regulation.

Table 9. Estimated DWL

| Metropolitan Area | DWL |
|---|---|
| **Atlanta** | $7,701,585,925 |
| **Baltimore** | $4,100,631,509 |
| **Boston** | $15,500,862,269 |
| **Chicago** | $14,290,517,354 |
| **Cincinnati** | $207,233,800 |
| **Cleveland** | $581,391,111 |
| **Dallas** | $2,417,846,396 |
| **Detroit** | $346,294,942 |
| **Houston** | $412,980,556 |
| **Kansas City** | $158,723 |
| **Los Angeles** | $63,087,476,381 |
| **Miami** | $3,742,496,065 |
| **Milwaukee** | $153,758,774 |
| **Minneapolis** | $2,165,725,495 |

| Metropolitan Area | DWL |
|---|---|
| **New York** | $54,978,820,593 |
| **Newark** | $14,818,910,523 |
| **Philadelphia** | $2,092,035,557 |
| **Phoenix** | $2,752,841,801 |
| **Pittsburgh** | $542,004 |
| **Riverside** | $2,226,174,884 |
| **San Diego** | $26,454,054,167 |
| **San Francisco** | $65,284,286,739 |
| **Seattle** | $28,883,735,348 |
| **St. Louis** | $827,216 |
| **Tampa** | $37,937,273 |

The estimates for P and DWL are suggestive, not definitive. However, they still give an excellent general idea of the extreme cost of zoning regulation in many metropolitan areas. The size of the DWL in some markets such as New York, San Francisco, and Los Angeles is enormous. It is hard to image that any external costs caused by an expansion of residential housing could come close to the DWL from zoning regulation.

The total cost of the zoning tax for high-cost markets is simply staggering. As mentioned earlier, much of the zoning tax "revenue" is similar to a DWL because it is due to land that is being withheld from development as opposed to revenue being collected for land-use restrictions such as permit fees. The combination of this massive total effective DWL and inefficient transfer of wealth to local governments for redistribution in high-cost markets is like an anchor impeding real economic growth.

## D. REGRESSION ANALYSIS OF DWL AND REGULATION

Malpezzi (1996) provides an index of land-use regulation for 56 metropolitan areas. The index considers seven different variables of zoning regulation, including mean time for permit approval, total single-family zoned acreage, and percentage of zoning changes approved. The index ranges from 7 to 35, with 7 being the lowest amount of regulation and 35 being the highest. The Malpezzi (1996) regulation index covers only 23

of the 25 metropolitan areas in this paper, with Seattle and Riverside being omitted. The regulation index for the 23 metropolitan areas covered are in Table 10.

Table 10. Regulation Index

| Metropolitan Area | Regulation Index |
|---|---|
| **Atlanta** | 20 |
| **Baltimore** | 20 |
| **Boston** | 26 |
| **Chicago** | 13 |
| **Cincinnati** | 22 |
| **Cleveland** | 21 |
| **Dallas** | 15 |
| **Detroit** | 17 |
| **Houston** | 21 |
| **Kansas City** | 19 |
| **Los Angeles** | 25 |
| **Miami** | 24 |
| **Milwaukee** | 18 |
| **Minneapolis** | 16 |
| **New York** | 26 |
| **Newark** | 25 |
| **Philadelphia** | 24 |
| **Phoenix** | 18 |
| **Pittsburgh** | 23 |
| **San Diego** | 26 |
| **San Francisco** | 29 |
| **St. Louis** | 16 |
| **Tampa** | 17 |

A linear regression is performed of the estimated DWL values (column 2 of Table 9) on the regulation index values (column 2 Table 10) for these 23 metropolitan areas, with DWL as the dependent variable and the regulation index as the independent variable. The results of the regression analysis are displayed in Table 11.

As expected, there is a statistically significant positive correlation between the measure of land-use regulation and estimated DWL from the zoning tax, with a p-value

of .00154 and $R^2$ of .3864. According to this model, an increase of 1 unit in the regulation index will result in an increase of approximately $3.0 Billion in DWL.

The correlation between the land-use regulation index created by Malpezzi (1996) and the measure of DWL calculated in this paper adds additional weight to the theory that zoning restrictions are the primary driver of housing supply constraints and high housing prices in many metropolitan areas.

Table 11. Linear Regression of DWL on Regulation Index

| **Regression Statistics** | |
|---|---|
| *Intercept* | -50,491,273,473.1703 |
| *Regulation Index Coefficient* | 2,998,811,860.8232 |
| *R* | 0.6216 |
| $R^2$ | 0.3864 |
| *Standard Error* | 1.64897E+10 |
| *N* | 23 |
| *Significance level (α)* | .05 |
| *p-value* | 0.00154 |

# IV. NET EFFECT ON BAH RATES

## A. BAH METHODOLOGY

The Defense Travel Management Office (DTMO) calculates Basic Allowance for Housing (BAH) rates annually for 364 Military Housing Areas (MHAs). The three components of the BAH rate calculation are median market rent, average utilities, and average renter's insurance (*Primer on BAH*, 2013). The data used to determine median rent are collected from multiple sources, including real estate rental listings, real estate management companies, real estate professionals, and base housing offices. Data are collected for apartments, townhouses, and single-family houses. Each rank is tied to a specific type of housing unit, which varies based on dependent status. "With dependents" means the service member is married or has a dependent child. Having dependents entitles the service member to a higher BAH rate. The BAH rate for the rank of O-3 with dependents, which uses the average market rent for a 3-bedroom detached single-family house, is used as the baseline BAH rate in this paper (*Primer on BAH*, 2013). The data for utilities are gathered from the American Community Survey (ACS), while the average cost of renter's insurance is determined using data from major insurance companies (*Primer on BAH*, 2013).

DTMO provides a BAH component breakdown for each MHA. The percentage breakdown for rent, utilities, and insurance is calculated as an average value across all ranks. Median rent makes up the majority of the BAH rate calculation. For the 364 MHAs in 2012 it averaged 75.9%, with a low of 61% and a high of 91% (*BAH Component Breakdown*, 2012).

In 2012, total BAH outlays were approximately $19 Billion for the Department of Defense (DOD), not including supplemental appropriations or Overseas Contingency Operations (OCO) funding (*Air Force Fiscal Year 2012 Budget Estimate*, 2011; *Army Fiscal Year 2012 Budget Estimate,* 2011; *Department of the Navy Fiscal Year 2012 President's Budget*, 2011). BAH outlays were for active duty service members in the Navy, Marine Corps, Army, and Air Force. BAH obligations comprise approximately

13% of the DOD's military personnel costs (*National Defense Budget Estimates,* 2013). This is a significant budget obligation that is directly influenced by rent and, ultimately, housing prices.

Rent and house prices are highly correlated. This comes as no surprise because theoretically the price of a house should be the present value of all future rental income minus expenses. The rent-price ratio is the primary metric used to measure the relationship between house prices and rent. The rent-price ratio is simply the average annual rent divided by median house price. Historically, this ratio has remained remarkably constant, averaging approximately 5% (Davis et al., 2008). Between 1960 and 1995, the rent-price ratio varied only from 4.8% to 6%. During this same period, house prices and rents increased in real terms at approximately the same rate (Davis et al., 2008). However, after 1995 the rate began a sharp decline, bottoming out in 2006 at approximately 3.5%. This unprecedented decline in the rent-price ratio from 1996 to 2006 happened concurrently with an extraordinary rise in housing prices across the U.S., leading many to believe there was a housing bubble (Shiller, 2005). Between 2006 and 2012 the rent-price ratio climbed back to its historical level of 5% (*Gross Rent-Price Ratio*, 2014). This reversion to the historical mean confirms the importance of the rent-price ratio as a valuable metric and the close correlation between house prices and rent.

## B. CALCULATION OF BAH RATES WITHOUT ZONING TAX

Any reduction in the price of housing will result in a proportional decrease in rent over the long run. BAH rates for the rank of O-3 with dependents in each metropolitan area is displayed in column 3 of Table 12. A linear regression analysis of the 2012 BAH rate on the 2012 Median House Price ($P^I$) is performed. The results are displayed in Table 14. The results show a statistically significant strong positive correlation between BAH and median house price. This outcome reinforces the high correlation between rent and house prices because rent makes up the majority of the BAH rate.

The percentage of BAH that is comprised of median rent is provided in column 5 of Table 12. To calculate the decrease in BAH resulting from a 100% reduction to the zoning tax, the calculated *implicit zoning tax percentage* from Table 3 is multiplied by

rent as a percent of BAH (column 5, Table 12) and the BAH rate (column 3, Table 12). The result is subtracted from the BAH rate to yield the BAH rate with a 100% zoning tax reduction. These values are displayed in column 4 of Table 13. Calculations for the BAH rate with a 75% and a 50% reduction to the zoning tax are also calculated by adjusting the implicit zoning tax percentage accordingly. These values are in columns 5 and 6 of Table 13, respectively.

The results show significant decreases in many high-cost areas. San Diego, which has a large military population due to numerous Navy and Marine Corps bases, shows an estimated BAH reduction of 47% with a complete elimination of the zoning tax. While a 100% reduction of the zoning tax is likely to be politically infeasible, as discussed earlier, these results are still valuable because they show the significant decreases to both rent prices and government spending on BAH entitlements that are possible from zoning regulation reform. A more reasonable reduction to the zoning tax of 50% still yields an estimated 24% decrease to the BAH rate in San Diego.

Table 12. BAH Rates

| Metropolitan Area | Median House Price (2012 ACS) ($P^I$) | 2012 BAH Rate (O-3 with dependents) | Implicit Zoning Tax Percent | Rent as a % of BAH Rate |
|---|---|---|---|---|
| **Atlanta** | $160,800 | $1,470 | 34.08% | 75% |
| **Baltimore** | $271,100 | $2,238 | 26.65% | 80% |
| **Boston** | $356,500 | $2,913 | 50.69% | 82% |
| **Chicago** | $215,100 | $2,031 | 33.17% | 81% |
| **Cincinnati** | $151,800 | $1,449 | 9.61% | 74% |
| **Cleveland** | $139,400 | $1,452 | 16.35% | 75% |
| **Dallas** | $158,200 | $1,782 | 23.58% | 77% |
| **Detroit** | $77,200 | $1,773 | 19.22% | 78% |
| **Houston** | $141,400 | $1,995 | 9.19% | 81% |
| **Kansas City** | $156,000 | $1,416 | -0.28% | 76% |
| **Los Angeles** | $399,500 | $2,625 | 51.24% | 89% |
| **Miami** | $181,500 | $2,190 | 36.31% | 83% |
| **Milwaukee** | $192,900 | $1,560 | 8.92% | 76% |
| **Minneapolis** | $203,700 | $1,872 | 20.03% | 82% |
| **New York** | $450,300 | $3,027 | 44.21% | 81% |
| **Newark** | $356,700 | $2,550 | 47.49% | 77% |
| **Philadelphia** | $244,000 | $2,253 | 17.40% | 77% |
| **Phoenix** | $156,100 | $1,611 | 24.55% | 79% |
| **Pittsburgh** | $124,300 | $1,929 | 0.50% | 79% |
| **Riverside** | $214,100 | $1,914 | 20.91% | 86% |
| **San Diego** | $386,400 | $2,316 | 53.48% | 88% |
| **San Francisco** | $719,800 | $3,015 | 70.94% | 91% |
| **Seattle** | $325,200 | $2,049 | 56.67% | 82% |
| **St. Louis** | $155,200 | $1,653 | 0.52% | 76% |
| **Tampa** | $132,400 | $1,989 | 3.91% | 80% |

Table 13. BAH Rates with Zoning Tax Reduction

| Metropolitan Area | Median House Price (2012 ACS) ($P^I$) | 2012 BAH Rate (O-3 with dependents) | BAH Rate w/ 100% Zoning Tax Reduction | BAH Rate w/ 75% Zoning Tax Reduction | BAH Rate w/ 50% Zoning Tax Reduction |
|---|---|---|---|---|---|
| **Atlanta** | $160,800 | $1,470 | $1,094 | $1,188 | $1,282 |
| **Baltimore** | $271,100 | $2,238 | $1,761 | $1,880 | $1,999 |
| **Boston** | $356,500 | $2,913 | $1,702 | $2,005 | $2,308 |
| **Chicago** | $215,100 | $2,031 | $1,485 | $1,622 | $1,758 |
| **Cincinnati** | $151,800 | $1,449 | $1,346 | $1,372 | $1,397 |
| **Cleveland** | $139,400 | $1,452 | $1,274 | $1,318 | $1,363 |
| **Dallas** | $158,200 | $1,782 | $1,458 | $1,539 | $1,620 |
| **Detroit** | $77,200 | $1,773 | $1,507 | $1,574 | $1,640 |
| **Houston** | $141,400 | $1,995 | $1,847 | $1,884 | $1,921 |
| **Kansas City** | $156,000 | $1,416 | $1,419 | $1,418 | $1,417 |
| **Los Angeles** | $399,500 | $2,625 | $1,428 | $1,727 | $2,026 |
| **Miami** | $181,500 | $2,190 | $1,530 | $1,695 | $1,860 |
| **Milwaukee** | $192,900 | $1,560 | $1,454 | $1,481 | $1,507 |
| **Minneapolis** | $203,700 | $1,872 | $1,564 | $1,641 | $1,718 |
| **New York** | $450,300 | $3,027 | $1,943 | $2,214 | $2,485 |
| **Newark** | $356,700 | $2,550 | $1,618 | $1,851 | $2,084 |
| **Philadelphia** | $244,000 | $2,253 | $1,951 | $2,027 | $2,102 |
| **Phoenix** | $156,100 | $1,611 | $1,299 | $1,377 | $1,455 |
| **Pittsburgh** | $124,300 | $1,929 | $1,921 | $1,923 | $1,925 |
| **Riverside** | $214,100 | $1,914 | $1,570 | $1,656 | $1,742 |
| **San Diego** | $386,400 | $2,316 | $1,226 | $1,499 | $1,771 |
| **San Francisco** | $719,800 | $3,015 | $1,069 | $1,555 | $2,042 |
| **Seattle** | $325,200 | $2,049 | $1,097 | $1,335 | $1,573 |
| **St. Louis** | $155,200 | $1,653 | $1,646 | $1,648 | $1,650 |
| **Tampa** | $132,400 | $1,989 | $1,927 | $1,942 | $1,958 |

Table 14. Linear Regression of BAH Rate on $P^I$

| **Regression Statistics** | |
|---|---|
| *Intercept* | 1349.1160 |
| *$P^I$ Coefficient* | 0.0029 |
| *R* | 0.83165 |
| *$R^2$* | 0.69164 |
| *Standard Error* | 275.09985 |
| *N* | 25 |
| *Significance level (α)* | .05 |
| *p-value* | 2.59E-07 |

# V. CONCLUSION

While the calculations in this paper are suggestive, the results show the significant cost imposed by zoning regulation. The net loss to society for the benefit of incumbent homeowners is particularly severe in the high-cost markets. The unrealized potential that exists is significant if the burden of the zoning tax can be lifted or eased, even by a small amount. Local governments can address negative externalities from land development in more efficient ways, such as infrastructure development. These externalities can also be internalized through private bargaining via covenants and homeowner associations (HOAs), as opposed to coerced regulation.

Why do nearly all zoning regulations and other land-use restrictions favor single-family homes and existing homeowners above all else? Fischel (2004) believes it began with a shift in judicial preferences during the early 20th century, favoring single-family homes as representing American ideals. In the 1970s the power of existing suburban homeowners increased due to a transition toward even more burdensome and restrictive land-use regulations throughout the country (Quigley & Rosenthal, 2005). The primary reason for the continuation of such onerous land-use restrictions in so many metropolitan areas is likely the concentrated benefits they provide to the existing local homeowners, while the significant costs are dispersed primarily to renters and budding home buyers.

Reducing zoning regulation will lower housing costs, increase homeownership in a sustainable and permanent way, and result in real economic growth. This significant net benefit to society should not be abdicated to the interests of one group.

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